### Empiric Therapy of Cardiovascular Infections

#### Subacute Bacterial Endocarditis (SBE)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>PO Therapy or IV-to-PO Switch</th>
</tr>
</thead>
</table>
| **No obvious source** | S. viridans  
Group B,C,G streptococci  
Nutritionally-variant streptococci | Ceftriaxone  
2 gm (IV) q24h  
x 2 weeks  
plus  
Gentamicin  
120 mg (IV) q24h  
x 2 weeks  
or monotherapy  
with  
Ceftriaxone  
2 gm (IV) q24h  
x 2 weeks | Penicillin G  
3 mu (IV) q4h  
x 2 weeks  
plus  
Gentamicin  
180 mg (IV) q24h  
x 2 weeks  
or monotherapy  
with  
Vancomycin  
1 gm (IV) q12h  
x 2 weeks  
or Linezolid  
600 mg (IV) q12h  
x 2 weeks | Amoxicillin  
1 gm (PO) q8h  
x 2 weeks  
or Linezolid  
600 mg (PO) q12h  
x 2 weeks |
| **GI/GU source likely** | E. faecalis  
(Treat initially  
for E. faecalis;  
if later  
identified as E. faecium, treat  
accordingly) | Vancomycin  
1 gm (IV) q12h  
x 4-6 weeks  
plus  
Gentamicin  
80 mg (IV) q8h  
x 4-6 weeks  
or monotherapy  
with  
Ampicillin  
2 gm (IV) q4h  
x 4-6 weeks | Meropenem  
1 gm (IV) q8h  
x 4-6 weeks  
or Imipenem  
1 gm (IV) q8h  
x 4-6 weeks  
or Linezolid  
600 mg (IV) q12h  
x 4-6 weeks | Amoxicillin  
1 gm (PO) q8h  
x 4-6 weeks  
or Linezolid  
600 mg (PO) q12h  
x 4-6 weeks |
| E. faecium (VRE) | Linezolid  
600 mg (IV) q12h  
x 4-6 weeks | Quinupristin/  
dalfopristin  
7.5 mg/kg (IV) q8h  
x 4-6 weeks | Linezolid  
600 mg (PO) q12h  
x 4-6 weeks |
| S. bovis | Treat the same as "no obvious source" subset, above |
# Subacute Bacterial Endocarditis (SBE) (cont’d)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>PO Therapy or IV-to-PO Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparent “culture-negative” SBE*</td>
<td>Hemophilus sp.</td>
<td>Ceftriaxone 2 gm (IV) q24h x 4 weeks</td>
<td>Ampicillin 2 gm (IV) q4h x 4 weeks plus either Gentamicin 120 mg (IV) q24h x 4 weeks or Levofloxacin 500 mg (IV) q24h x 4-6 weeks</td>
<td>Levofloxacin 500 mg (PO) q24h x 4-6 weeks</td>
</tr>
<tr>
<td></td>
<td>Actinobacillus actinomycetemcomitans</td>
<td>or Any 3rd generation cephalosporin (IV) x 4 weeks</td>
<td>or Cefepime 2 gm (IV) q12h x 4 weeks</td>
<td>or Ciprofloxacin 500 mg (PO) q12h x 4 weeks</td>
</tr>
<tr>
<td></td>
<td>Cardiobacterium hominis</td>
<td>or Eikenella corrodens</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kingella kingae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>True “culture-negative” SBE*</td>
<td>Legionella</td>
<td>Levofloxacin 500 mg (IV) q24h x 4-6 weeks</td>
<td>Doxycycline 200 mg (IV) q12h x 3 days, then 100 mg (IV) q12h x 4-6 weeks</td>
<td>Doxycycline 200 mg (PO) q12h x 3 days, then 100 mg (PO) q12h x 4-6 weeks* or Levofloxacin 500 mg (PO) q24h x 4-6 weeks</td>
</tr>
<tr>
<td></td>
<td>Coxiella burnetii (Q fever)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlamydia psittaci</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Brucella</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

URE = vancomycin-resistant enterococci. Duration of therapy represents total time IV, PO, or IV + PO. Most patients on IV therapy able to take PO meds should be switched to PO therapy soon after clinical improvement.
* Treat only IV or IV-to-PO switch.
** Loading dose is not needed PO if given IV with the same drug.

**Clinical Presentation:** Subacute febrile illness ± localizing symptoms/signs in a patient with a heart murmur. Peripheral manifestations are commonly absent with early diagnosis/treatment.

**Diagnosis:** Positive blood cultures plus vegetation on transthoracic/transesophageal echo.

**SBE (No Obvious Source)**

**Diagnostic Considerations:** Most common pathogen is S. viridans. Source is usually from the mouth, although oral/dental infection is usually inapparent clinically.

**Pitfalls:** Vegetations without positive blood cultures or peripheral manifestations of SBE are not diagnostic of endocarditis. SBE vegetations may persist after antibiotic therapy, but are sterile.

**Therapeutic Considerations:** In penicillin-allergic (anaphylactic) patients, vancomycin may be used alone or in combination with gentamicin. Follow ESR weekly to monitor antibiotic response. No need to repeat blood cultures unless patient has persistent fever or is not responding clinically. Two-week treatment is acceptable for uncomplicated S. viridans SBE. Treat nutritionally-variant streptococci (B6/pyridoxal deficient streptococci) the same as for S. viridans SBE.

**Prognosis:** Related to extent of embolization/severity of heart failure.

**SBE (GI/GU Source Likely)**

**Diagnostic Considerations:** Commonest pathogens from GI/GU source are Enterococci (especially E. faecalis). If S. bovis, look for GI polyp, tumor. Enterococcal SBE commonly follows GI/GU instrumentation.

**Therapeutic Considerations:** E. faecalis SBE may be treated with ampicillin alone; gentamicin may be added if synergy testing is positive (e.g., isolate sensitive to < 500 mcg/mL of gentamicin). Do not
add gentamicin if MIC > 500 mcg/mL. For penicillin-allergic patients, use vancomycin plus gentamicin; vancomycin alone is inadequate for enterococcal (E. faecalis) SBE. Treat enterococcal PVE the same as for native valve enterococcal SBE. Treat S. bovis SBE the same as S. viridans SBE. Non-enterococcal Group D streptococci (S. bovis) is penicillin sensitive, unlike Group D enterococci (E. faecalis).

**Prognosis:** Related to extent of embolization/severity of heart failure

**Apparent “Culture Negative” SBE**

**Diagnostic Considerations:** Culture of HACEK organisms requires enhanced CO₂/special media (Castaneda vented bottles) and prolonged incubation (2-4 weeks). True "culture negative" SBE is rare, and is characterized by peripheral signs of SBE with a murmur, vegetation, and negative blood cultures.

**Pitfalls:** Most cases of "culture negative" SBE are not really culture negative, but due to fastidious organisms (HACEK group) requiring prolonged incubation with enhanced CO₂ atmosphere for growth. Sterile vegetations may persist after antibiotic therapy.

**Therapeutic Considerations:** Follow clinical improvement with serial ESRs, which should return to pretreatment levels with therapy. Verification of cure by blood culture is not needed if patient is afebrile and clinically well.

**Prognosis:** Related to extent of embolization/severity of heart failure.

**True “Culture Negative” SBE**

**Diagnostic Considerations:** Diagnosis by specific serology. Large vessel emboli suggests culture negative SBE in patients with negative blood cultures but signs of SBE.

**Pitfalls:** Do not diagnose culture negative SBE in patients with a heart murmur and negative blood cultures if peripheral SBE manifestations are absent.

**Therapeutic Considerations:** Treatment is based on specific organism identified by diagnostic tests.

**Prognosis:** Related to extent of embolization/severity of heart failure.

### Acute Bacterial Endocarditis (ABE)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>PO Therapy or IV-to-PO Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Normal hosts</strong></td>
<td>S. aureus (MSSA)</td>
<td>Nafcillin 2 gm (IV) q4h x 4-6 weeks</td>
<td>Linezolid 600 mg (IV) q12h x 4-6 weeks</td>
<td>Minocycline 100 mg (PO) q12h x 4-6 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Meropenem 1 gm (IV) q8h x 4-6 weeks</td>
<td>or Vancomycin 1 gm (IV) q12h x 4-6 weeks</td>
<td>or Cephalexin 1 gm (PO) q6h x 4-6 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Imipenem 1 gm (IV) q6h x 4-6 weeks</td>
<td>or Linezolid 600 mg (PO) q12h x 4-6 weeks</td>
<td>or Linezolid 600 mg (PO) q12h x 4-6 weeks</td>
</tr>
<tr>
<td></td>
<td>S. aureus (MRSA)</td>
<td>Vancomycin 1 gm (IV) q12h x 4-6 weeks</td>
<td>Minocycline 100 mg (IV) q12h x 4-6 weeks</td>
<td>Minocycline 100 mg (PO) q12h x 4-6 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Linezolid 600 mg (IV) q12h x 4-6 weeks</td>
<td>or Minocycline 100 mg (PO) q12h x 4-6 weeks</td>
<td>or Minocycline 100 mg (PO) q12h x 4-6 weeks</td>
</tr>
</tbody>
</table>
### Acute Bacterial Endocarditis (ABE) (cont’d)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>PO Therapy or IV-to-PO Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV drug abusers (MSSA)</td>
<td>Before culture results</td>
<td>Vancomycin 1 gm (IV) q12h <strong>plus either</strong> Gentamicin 120 mg (IV) q24h <strong>or</strong> Amikacin 500 mg (IV) q24h</td>
<td>After culture results</td>
<td>After culture results</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Nafinol 2 gm (IV) q4h x 4 weeks <strong>or</strong> Meropenem 1 gm (IV) q8h x 4 weeks <strong>or</strong> Imipenem 1 gm (IV) q6h x 4 weeks <strong>or</strong> Vancomycin 1 gm (IV) q12h x 4 weeks <strong>or</strong> Linezolid 600 mg (IV) q12h x 4 weeks</td>
<td>Linezolid 600 mg (PO) q12h x 4 weeks <strong>or</strong> Minocycline 100 mg (PO) q12h x 4 weeks <strong>or</strong> Cephalexin 1 gm (PO) q6h x 4 weeks</td>
</tr>
<tr>
<td>S. aureus (MRSA)</td>
<td>Before culture results</td>
<td>Vancomycin 1 gm (IV) q12h x 4 weeks <strong>or</strong> Linezolid 600 mg (IV) q12h x 4 weeks <strong>or</strong> Minocycline 100 mg (IV) q12h x 4 weeks</td>
<td>After culture results</td>
<td>After culture results</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Linezolid 600 mg (PO) q12h x 4 weeks <strong>or</strong> Minocycline 100 mg (PO) q12h x 4 weeks</td>
</tr>
<tr>
<td>P. aeruginosa*</td>
<td>Before culture results</td>
<td>One “A” drug + one “B” drug <strong>A</strong> Drugs Piperacillin 4 gm (IV) q8h x 4-6 weeks <strong>or</strong> Cefepime 2 gm (IV) q8h x 4-6 weeks <strong>or</strong> Meropenem 1 gm (IV) q8h x 4-6 weeks <strong>B</strong> Drugs Amikacin 500 mg (IV) q24h x 4-6 weeks <strong>or</strong> Aztreonam 2 gm (IV) q8h x 4-6 weeks</td>
<td>After culture results</td>
<td>After culture results</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ciprofloxacin 750 mg (PO) q12h x 4-6 weeks</td>
</tr>
</tbody>
</table>

**MSSA/MRSA** = methicillin-sensitive/resistant S. aureus. Duration of therapy represents total time IV, PO, or IV + PO. Most patients on IV therapy able to take PO meds should be switched to PO therapy after clinical improvement.

* Treat only IV or IV-to-PO switch
Acute Bacterial Endocarditis

Diagnostic Considerations: Patients are critically ill and febrile (temperature \( \geq 102^\circ F \)). Vegetations are almost always present.

Pitfalls: Obtain a baseline echocardiogram; watch for valve destruction, heart failure, ring/perivalvular abscess. Obtain cardiology consultation.

Therapeutic Considerations: Treat for 4-6 weeks. Follow teichoic acid antibody levels weekly in S. aureus ABE, which fall (along with the ESR) with effective therapy.

Prognosis: Related to extent of embolization/severity of heart failure.

Acute Bacterial Endocarditis (IV Drug Abusers)

Diagnostic Considerations: IVDAs with S. aureus usually have mild ABE, permitting oral treatment.

Therapeutic Considerations: After pathogen is isolated, may switch from IV to PO regimen to complete treatment course.

Prognosis: Prognosis is better than for normal hosts (endocarditis usually milder) if not complicated by abscess, valve regurgitation, or heart failure.

Prosthetic Valve Endocarditis (PVE)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Before Culture Results</th>
<th>After Culture Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early PVE (&lt; 60 days post-PVR)</td>
<td>S. aureus (MSSA/MRSA) Enterobacteriaceae</td>
<td>Vancomycin 1 gm (IV) q12h plus Gentamicin 120 mg (IV) q24h</td>
<td>MSSA/Enterobacteriaceae Cefotaxime 3 gm (IV) q6h x 4-6 weeks or Ceftriaxone 4 gm (IV) q8h x 4-6 weeks or Cefepime 2 gm (IV) q8h x 4-6 weeks or Meropenem 1 gm (IV) q8h x 4-6 weeks</td>
</tr>
<tr>
<td>Late PVE (&gt; 60 days post-PVR)</td>
<td>S. viridans S. epidermidis (MSSE/MRSE)</td>
<td>Linezolid 600 mg (IV or PO) q12h or combination therapy with Vancomycin 1 gm (IV) q12h plus Gentamicin 120 mg (IV) q24h</td>
<td>S. viridans Ceftriaxone 2 gm (IV) q24h x 4-6 weeks or Cefotaxime 3 gm (IV) q6h x 4-6 weeks or Cefepime 2 gm (IV) q8h x 4-6 weeks or Meropenem 1 gm (IV) q8h x 4-6 weeks</td>
</tr>
</tbody>
</table>

MSSA/MRSA = methicillin-sensitive/resistant S. aureus; MSSE/MRSE = methicillin-sensitive/resistant S. epidermidis.

Duration of therapy represents total time IV or IV + PO. Most patients on IV therapy able to take PO meds should be switched to PO therapy after clinical improvement.

* = Rifampin 300 mg (PO) q12h x 4-6 weeks
Clinical Presentation: Prolonged fevers and chills following prosthetic valve replacement (PVR)
Diagnosis: High-grade blood culture positivity (3/4 or 4/4) with endocarditis pathogen and no other source of infection

Early PVE (< 60 days post-PVR)
Diagnostic Considerations: Blood cultures persistently positive. Temperature usually ≤ 102°F
Pitfalls: Obtain baseline TTE/TEE. Premature closure of mitral leaflet is early sign of impending aortic valve regurgitation
Therapeutic Considerations: Patients improve clinically on treatment, but are not cured without valve replacement. Replace valve as soon as possible (no advantage in waiting)
Prognosis: Related to extent of embolization/severity of heart failure

Late PVE (> 60 days post-PVR)
Pitfalls: Culture of removed valve may be negative, but valve gram stain will be positive
Therapeutic Considerations: Late PVE resembles S. viridans SBE clinically. Valve removal for S. epidermidis PVE may be necessary for cure
Prognosis: Related to extent of embolization/severity of heart failure

Pericarditis/Myocarditis

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viral pericarditis/</td>
<td>Coxsackie virus</td>
<td>No treatment available</td>
</tr>
<tr>
<td>myocarditis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TB pericarditis</td>
<td>M. tuberculosis</td>
<td>Treat the same as pulmonary TB (p. 44)</td>
</tr>
<tr>
<td>Suppurative pericarditis</td>
<td>S. pneumoniae</td>
<td>Treat the same as lung abscess/empyema (p. 49)</td>
</tr>
<tr>
<td></td>
<td>S. aureus</td>
<td></td>
</tr>
</tbody>
</table>

Clinical Presentation: Viral pericarditis presents with acute onset of fever/chest pain (made worse by sitting up) following a viral illness. Viral myocarditis presents with heart failure, arrhythmias ± emboli. TB pericarditis is indolent in presentation, with ↑ jugular venous distension (JVD), pericardial friction rub (40%), paradoxical pulse (25%), and chest x-ray with cardiomegaly ± left-sided pleural effusion. Suppurative pericarditis presents as acute pericarditis (patients are critically ill). Develops from contiguous (e.g., pneumonia) or hematogenous spread (e.g., S. aureus bacteremia)

Diagnostic Considerations: Pericarditis/effusion manifests cardiomegaly with decreased heart sounds ± tamponade. Diagnosis by culture/biopsy of pericardial fluid or pericardium for viruses, bacteria, or acid-fast bacilli (AFB). Diagnosis of myocarditis is clinical ± myocardial biopsy

Pitfalls: Consider other causes of pericardial effusion (malignancy, especially with bloody effusion, uremia, etc.). Rule out treatable non-viral causes of myocarditis (e.g., RMSF, Lyme disease, diphtheria)

Therapeutic Considerations: No specific treatment for viral myocarditis/pericarditis. TB pericarditis is treated the same as pulmonary TB ± pericardectomy. Suppurative pericarditis is treated the same as lung abscess plus surgical drainage (pericardial window)

Prognosis: For viral pericarditis, the prognosis is good, but viral myocarditis may be fatal. For TB pericarditis, the prognosis is good if treated before constrictive pericarditis/adhesions develop. Suppurative pericarditis is often fatal without early pericardial window/antibiotic therapy
### IV Line and Pacemaker Infections

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>IV-to-PO Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central IV line infection (temporary)</td>
<td><em>S. aureus</em> (MSSA) Enterobacteriaceae</td>
<td>Cefepime 2 gm (IV) q12h x 2 weeks after line removal</td>
<td>Ceftizoxime 2 gm (IV) q8h x 2 weeks after line removal</td>
<td>Clindamycin 300 mg (PO) q8h x 2 weeks after line removal plus Levofloxacin 500 mg (PO) q24h x 2 weeks after line removal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Meropenem 1 gm (IV) q8h x 2 weeks after line removal</td>
<td>or Cefotaxime 2 gm (IV) q8h x 2 weeks after line removal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Imipenem 1 gm (IV) q6h x 2 weeks after line removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. aureus (MRSA)</td>
<td></td>
<td>Linezolid 600 mg (IV) q12h x 2 weeks after line removal</td>
<td>Minocycline 100 mg (IV) q12h x 2 weeks after line removal</td>
<td>Linezolid 600 mg (PO) q12h x 2 weeks after line removal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Vancomycin 1 gm (IV) q12h x 2 weeks after line removal</td>
<td>or Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks after line removal</td>
<td>or Minocycline 100 mg (PO) q12h x 2 weeks after line removal</td>
</tr>
<tr>
<td>Central IV line infection (semi-permanent); Hickman/Broviac</td>
<td><em>S. aureus</em> (MSSA/MRSA)</td>
<td>Linezolid 600 mg (IV) q12h x 2 weeks after line removal</td>
<td>Minocycline 100 mg (IV) q12h x 2 weeks after line removal</td>
<td>Linezolid 600 mg (PO) q12h x 2 weeks after line removal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Vancomycin 1 gm (IV) q12h x 2 weeks after line removal</td>
<td>or Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks after line removal</td>
<td>or Minocycline 100 mg (PO) q12h x 2 weeks after line removal</td>
</tr>
<tr>
<td></td>
<td><em>S. epidermidis</em> (MSSE/MRSE)</td>
<td>Linezolid 600 mg (IV) q12h x 2 weeks after line removal</td>
<td>Cefepime 2 gm (IV) q12h x 2 weeks after line removal</td>
<td>Linezolid 600 mg (PO) q12h x 2 weeks after line removal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or Vancomycin 1 gm (IV) q12h x 2 weeks after line removal</td>
<td>or Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks after line removal</td>
<td>or combination therapy with Clindamycin 300 mg (PO) q8h x 2 weeks after line removal plus Levofloxacin 500 mg (PO) q24h x 2 weeks after line removal</td>
</tr>
</tbody>
</table>
## IV Line and Pacemaker Infections (cont’d)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>IV-to-PO Switch</th>
</tr>
</thead>
</table>
| Pacemaker wire/generator infection (Treat initially for *S. aureus*; if later identified as *S. epidermidis*, treat accordingly) | *S. aureus* (MSSA/MRSA) | Linezolid 600 mg (IV) q12h x 2 weeks after wire/generator removal*  
  **or** Vancomycin 1 gm (IV) q12h x 2 weeks after wire/generator removal* | Minocycline 100 mg (IV) q12h x 2 weeks after wire/generator removal*  
  **or** Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks after wire/generator removal* | Linezolid 600 mg (PO) q12h x 2 weeks after wire/generator removal*  
  **or** Minocycline 100 mg (PO) q12h x 2 weeks after wire/generator removal* |
|                            | *S. epidermidis* (MSSE/MRSE) | Linezolid 600 mg (IV) q12h x 2 weeks after wire/generator removal  
  **or** Vancomycin 1 gm (IV) q12h x 2 weeks after wire/generator removal | Cefepime 2 gm (IV) q12h x 2 weeks after wire/generator removal  
  **or** Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks after wire/generator removal | Linezolid 600 mg (PO) q12h x 2 weeks after wire/generator removal  
  **or combination therapy with** Clindamycin 300 mg (PO) q8h x 2 weeks after wire/generator removal  
  **plus** Levofloxacin 500 mg (PO) q24h x 2 weeks after wire/generator removal |
| Septic thrombo-phlebitis (Treat initially for MSSA; if later identified as MRSA, treat accordingly) | *S. aureus* (MSSA) | Nafcillin 2 gm (IV) q4h x 2 weeks*  
  **or** Meropenem 1 gm (IV) q8h x 2 weeks*  
  **or** Imipenem 1 gm (IV) q6h x 2 weeks*  
  **or** Linezolid 600 mg (IV) q12h x 2 weeks* | Ceftriaxone 2 gm (IV) q8h x 2 weeks*  
  **or** Cefotaxime 2 gm (IV) q6h x 2 weeks*  
  **or** Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks* | Linezolid 600 mg (PO) q12h x 2 weeks*  
  **or combination therapy with** Clindamycin 300 mg (PO) q8h x 2 weeks*  
  **plus** Levofloxacin 500 mg (PO) q24h x 2 weeks* |
### IV Line and Pacemaker Infections (cont’d)

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>IV-to-PO Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic thrombophlebitis (cont’d)</td>
<td>S. aureus (MRSA)</td>
<td>Linezolid 600 mg (IV) q12h x 2 weeks* or Vancomycin 1 gm (IV) q12h x 2 weeks*</td>
<td>Minocycline 100 mg (IV) q12h x 2 weeks* or Quinupristin/dalfopristin 7.5 mg/kg (IV) q8h x 2 weeks*</td>
<td>Linezolid 600 mg (PO) q12h x 2 weeks* or Minocycline 100 mg (PO) q12h x 2 weeks*</td>
</tr>
</tbody>
</table>

MSSA/MSRA = methicillin-sensitive/resistant S. aureus; MSSE/MRSE = methicillin-sensitive/resistant S. epidermidis.

Duration of therapy represents total time IV or IV + PO. Most patients on IV therapy able to take PO meds should be switched to PO therapy after clinical improvement.

* Obtain teichoic acid antibody titers after 2 weeks. If titers are 1:4 or less, 2 weeks of therapy is sufficient. If titers are > 1:4, rule out endocarditis and complete 4-6 weeks of therapy.

### Central IV Line Infection (Temporary)

**Clinical Presentation:** Temperature ≥ 102°F ± IV site erythema

**Diagnostic Considerations:** Diagnosis by semi-quantitative catheter tip culture with ≥ 15 colonies plus blood cultures with same pathogen. If no other explanation for fever and line has been in place ≥ 7 days, remove line and obtain semi-quantitative catheter tip culture. Suppurative thrombophlebitis presents with hectic/septic fevers and pus at IV site ± palpable venous cord.

**Pitfalls:** Temperature ≥ 102°F with IV line infection, in contrast to phlebitis.

**Therapeutic Considerations:** Line removal is usually curative, but antibiotic treatment is usually given for 2 weeks after line removal.

**Prognosis:** Good if line is removed before endocarditis/metastatic spread.

### Central IV Line Infection (Semi-Permanent) Hickman/Broviac

**Clinical Presentation:** Fever ± IV site erythema

**Diagnostic Considerations:** Positive blood cultures plus gallium scan pickup on catheter is diagnostic.

**Pitfalls:** Antibiotics will lower temperature, but patient will usually not be afebrile without line removal.

**Therapeutic Considerations:** Lines usually need to be removed for cure. Rifampin 600 mg (PO) q24h may be added to IV/PO regimen if pathogen is S. aureus.

**Prognosis:** Good with organisms of low virulence.

### Pacemaker Wire/Generator Infection

**Clinical Presentation:** Persistently positive blood cultures without endocarditis in a pacemaker patient.

**Diagnostic Considerations:** Positive blood cultures with gallium scan pickup on wire/pacemaker generator is diagnostic. Differentiate wire from pacemaker pocket infection by chest CT/MRI.

**Pitfalls:** Positive blood cultures are more common in wire infections than pocket infections. Blood cultures may be negative in both, but more so with pocket infections.

**Therapeutic Considerations:** Wire alone may be replaced if infection does not involve pacemaker generator. Replace pacemaker generator if involved; wire if uninvolved can usually be left in place.

**Prognosis:** Good if pacemaker wire/generator replaced before septic complications develop.

### Septic Thrombophlebitis

**Clinical Presentation:** Temperature ≥ 102°F with local erythema and signs of sepsis.

**Diagnostic Considerations:** Palpable venous cord and pus at IV site when IV line is removed.

**Pitfalls:** Suspect diagnosis if persistent bacteremia and no other source of infection in a patient with...
**Aortic Graft Infection**

**Clinical Presentation:** Persistently positive blood cultures without endocarditis in a patient with an aortic graft

**Diagnostic Considerations:** Diagnosis by positive blood cultures plus gallium scan pickup over infected aortic graft or abdominal CT/MRI scan

**Pitfalls:** Infection typically occurs at anastomotic sites

**Therapeutic Considerations:** Graft must be removed for cure. Operate as soon as diagnosis is confirmed.

<table>
<thead>
<tr>
<th>Subset</th>
<th>Usual Pathogens</th>
<th>Preferred IV Therapy</th>
<th>Alternate IV Therapy</th>
<th>IV-to-PO Switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>AV graft/shunt infection</td>
<td>S. aureus (MSSA)</td>
<td>Vancomycin 1 gm (IV) x 1 dose*†</td>
<td>Meropenem 1 gm (IV) x 1 dose*†</td>
<td>Linezolid 600 mg (PO) x 1 dose*†</td>
</tr>
<tr>
<td>(Treat initially for MSSA, etc.; if later identified as MRSA, treat accordingly)</td>
<td>Enterococci Entero- bacteriaceae</td>
<td>plus Gentamicin 240 mg (IV) x 1 dose*†</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S. aureus (MRSA)</td>
<td>Linezolid 600 mg (IV) x 1 dose*†</td>
<td>Vancomycin 1 gm (IV) x 1 dose*†</td>
<td>Linezolid 600 mg (PO) x 1 dose*†</td>
</tr>
<tr>
<td>Aortic graft infection</td>
<td>S. aureus (MSSA)</td>
<td>Cefepime 2 gm (IV) q12h† or Meropenem 1 gm (IV) q8h† or Imipenem 1 gm (IV) q6h†</td>
<td>Ceftriaxone 2 gm (IV) q8h† or Cefotaxime 2 gm (IV) q6h†</td>
<td>Clindamycin 300 mg (PO) q8h† plus Levofloxacin 500 mg (PO) q24h†</td>
</tr>
<tr>
<td>Entero- bacteriaceae</td>
<td>Cefepime 2 gm (IV) q12h† or Meropenem 1 gm (IV) q8h† or Imipenem 1 gm (IV) q6h†</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MSSA/MRSA = methicillin-sensitive/resistant S. aureus. Duration of therapy represents total time IV or IV + PO. Most patients on IV therapy able to take PO meds should be switched to PO therapy after clinical improvement.

* Follow with maintenance dosing for renal failure (CrCl < 10 mL/min) and type of dialysis (see Chapter 7)
† Treat until graft is removed/replaced